Actionable Science for Communities

Wave Tank Oil Plume Simulations – SHC 3.62.1

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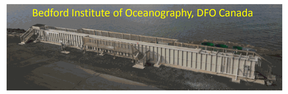
Purpose/Utility of Research

Oil plume dispersion simulation experiments have been conducted over the past 5 years in collaboration with the Canadian Government within the large-scale wave tank at the Bedford Institute of Oceanography.



This research is critical for advancing science with respect to aspects of spill preparedness, response, and remediation; particularly during Spills of National Significance.

Optical sensors are used during oil spill response to determine oil presence in slicks and plumes. *In situ* sensors were deployed during the Deepwater Horizon (DWH) oil spill to track shallow and deep subsea plumes. Tank simulations address knowledge gaps in uncertainties regarding sensor capabilities, plume formation, droplet size distribution (DSD), dispersion effectiveness, and oil transport.

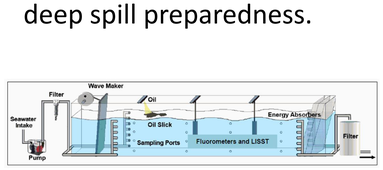
Simulation variables include:

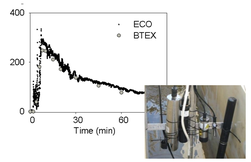
- Oil release type
- Oil temperature (reservoir temp ~ 80 ºC)
- Water temperature (5 ºC - 22 ºC)
- Oil type (ANS, SLC, IFO-120)
- Dispersant (Corexit 9500; Finasol OSR52)
- Dispersant to oil ratio (DOR)
- Salinity (20-100 ppt)

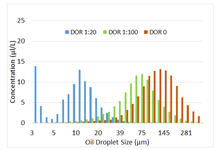
Results offer information on the behavior and dispersibility of oils, with implications for droplet formation and fate & transport numerical models.

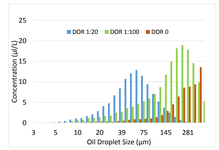
Highlights

- Simulation experiments provide for evaluating factors that influence oil dispersion and how forensic field sensors detect dispersed oils.
- Evaluation of *in situ* fluorometers used during the *Deepwater Horizon* oil spill demonstrated a detection of 300 ppb oil, refuting previous misconceptions of 1 ppm oil detection limit.
- Simulation research is critical for the Agency's spill preparedness and response efforts.
- Jet simulations inform SSDU (Sub-Surface Dispersant Use) planning by EPA OLEM, which coincides with the API (American Petroleum Institute) efforts.
- On-going simulations include dispersion under hypersaline water conditions for Arctic and deep spill preparedness.









Application & Translation

40 CFR Decision-rule Amendments

Performance evaluation of sensors via a novel approach for sensor assessment, calibration, and appropriateness was published in Conmy *et al.,* 2014 (ES&T). This manuscript serves as a citation within the Federal Register proposed decision-rule amendments to the 40 CFR § 300.900-920 subpart J for spill monitoring requirements.

Expert Witness Deposition

Conmy *et al.,* 2014 was also used by the Department of Justice as material during depositions for the DWH Clean Water Act Penalties trial.

EPA 600/R-16/152 Federal Report

A recent report summarized the high-pressure jet oil releases simulations for evaluating droplet fractionation and tuning the oil droplet formation numerical model, JETLAG used during DWH.

Scaling Up

BIO wave tank simulations have now translated to work at the larger OHMSETT facility.

Intended End users

- EPA Office of Land and Emergency Management
- National and Regional Response Teams
- Federal On-Scene Coordinators
- Oil spill emergency responders

Research products are used to:

1) Improve response monitoring guidance
2) Assist with Area Contingency Plans
3) Enhance spill preparedness
4) Serve as citations in 40 CFR decision rules

Lessons Learned

In US waters, intentional releases of oil are not permissible. For research purposes, permits are difficult to obtain and time-prohibited. Thus, oil dispersion simulation large-scale wave tanks are vital to advancing the science forward. This type of research has a large return on investment for the EPA and the oil spill community.

Research findings have translated to larger scale experiments at the US operated OHMSETT facility at Weapons Station Earle in Leonardo, NJ.

EPA initiated and executed Interagency Agreements (funds in to EPA) with Department of Interior's Bureau of Safety and Environmental Enforcement and the Department of Fisheries and Oceans Canada to conduct jet release research. Sensor calibration research was funded through NOAA.